FROST & SULLIVAN

BEST PRACTICES AWARDS

Sensium®

Wireless Vitals Monitoring

2020 EUROPEAN WEARABLE REMOTE PATIENT MONITORING TECHNOLOGY INNOVATION LEADERSHIP AWARD

Contents

Background and Company Performance

Industry Challenges

Healthcare systems worldwide are trying to cope with an aging population and a rising number of patients suffering from long-term, chronic conditions. The treatment of such conditions extracts a tremendous cost on healthcare systems. As per the US Center for Disease Control and Prevention, stroke, heart disease, and other cardiovascular diseases cost $213.8 billion annually and cause $137.4 billion in lost productivity from premature death.[1]

Most of the healthcare system burden occurs due to adverse events, leading to wasted hospital days. 75% of the adverse events and deaths occurring outside of the intensive care unit (ICU) can be prevented, relieving the pressure on health systems and alleviating patient suffering. It is estimated that diagnosis of conditions like sepsis result in a 7.6% increase in mortality every hour.[2]

Moreover, disruptions to healthcare access is increasing due to the current pandemic, spurring the adoption of digital monitoring solutions that remotely collect, store, and forward biometric readings. Recent innovations in wireless and remote patient monitoring have shown promising evidence in helping detect the advent of adverse events, thereby improving patient outcomes.[3] Technological advancements like wireless sensors, cloud-based network infrastructure, and artificial intelligence-based decision support combined with innovative care delivery models like remote monitoring, connected care, and tele-ICU has the potential to enable diagnosis and care delivery outside the high-acuity or hospital setting, thereby improving patient outcomes and decreasing the cost of care to patients, payers, and providers.

However, there is a lot of noise in the market with immature market entrants and a lack of evidence-based publications on product efficacy and outcomes. There is a significant gap between regulatory approval and the ability of a product to be successful in real-world scenarios (i.e., chaotic clinical environments that are vastly different from testing on healthy volunteers during clinical studies.) Currently, there are few market participants with evidence-based offerings that are proven in real-world deployments.

Technology Leverage and Business Impact

Technology Incubation and Application Diversity

Sensium is headquartered in the United Kingdom and is part of The Surgical Company Group. The Surgical Company Group comprises of 9 healthcare business with a shared goal of improving patient outcomes. The Group activities include innovative med tech development with a global customer footprint and European distribution businesses. The Surgical Company Group is headquartered out of Amersfoort NL.

[1] US Centers for Disease Control and Prevention, "Heart Disease and Stroke," Fast Facts, https://www.cdc.gov/chronicdisease/resources/publications/factsheets/heart-disease-stroke. (14 August 2020)
[2] https://www.oecd.org/els/health-systems/The-economics-of-patient-safety-March-2017.pdf
[3] https://doi.org/10.1016/j.injury.2019.11.018

Sensium was founded in 2000 as a technology start-up from Imperial College London. With the initial goal of developing low-power wireless technology, Sensium was further scaled to perform wireless vital signs monitoring. To that end, the company's Sensium System received FDA and CE approval in 2011 and 2013.

The Sensium System comprises of a lightweight disposable patch that relays patient vital sign data to a Sensium Bridge and then onto the Sensium Link server software package where clinicians can interact with the vital signs data.

The Sensium Patch is placed on the patient's chest and connects to standard electrocardiogram (ECG) electrodes that measure heart rate, respiration, and axillary temperature. The system provides accurate and continuous monitoring for early detection of patient deterioration in hospital wards. Frost & Sullivan notes the product is a treatment prompt rather than a mere monitoring product, and acts as a clinical early warning system for acute care. The System detects and notifies nurses and physicians on conditions such as sepsis, cardiac arrest, and respiratory depression, thus helping prevent the advent of hospital-based adverse events, the cost of which currently amounts to GBP 2.5 billion per year.

The Sensium System is featured in approximately 30 peer-reviewed articles, covering a range of research areas from product validation to outcome-based studies like sepsis prevention and reduction of length of stay. Unlike most competing offerings, the Sensium System has a significant amount of data published in peer-reviewed journals. The results indicate Sensium measures are accurate to +/- one beat for the heart rate and +/- one breath for the respiratory rate as compared to ICU reference monitors. Sensium differentiates itself from competitors due to the product's robust evidence base and real-word deployments.

Commitment to Exceptional Design and Creativity

The Sensium patch is disposable, lightweight, wireless, and automatically takes readings every 2 minutes, subsequently transmitting the data to a Sensium Bridge. Each Sensium Bridge can simultaneously connect with up to 16 Sensium Patches and each Sensium Patch can connect to any Sensium Bridge in the network. While competitors typically derive the respiratory rate via the ECG, there are accuracy concerns concerning the upper and lower end of the respiratory spectrum in critical cases. The Sensium patch instead uses impedance pneumography to monitor the respiratory rate, similar to high-end ICU monitors. The device uses a single-lead ECG to measure the electrical activity of the heart, and the patch also measures axillary temperature, a clinically appropriate surrogate for core body temperature. Hence, the Sensium System helps enhance recovery for post-surgical patients.

Communication protocols from the patch to bridge is done with radio frequency, an ultra-low power communication protocol, which has been developed by the company over the past 10 years. The protocol runs at about 1% of the power consumption of Wi-Fi, allowing the patch to last longer (e.g., 5 to 6 days). The Sensium patch can connect to any bridge in the hospital network, enabling up to 16 patches to connect to any bridge at any one

time. As a result, hospital patients enjoy improved mobility. Measures from the patch can be integrated into electronic health record hospital portals, thus reducing the risk of transcription errors. Moreover, the company uses HL7 protocols and allows for open API integration. The company has built native applications in iOS and Android, enabling end users to receive proactive notifications which are hassle-free and timely.

Commercialization Success and Growth Potential

Sensium's commercial model is quite flexible, and can be customized based on targets set by the hospitals. Recently the company has taken the route of value-based contracting by identifying and enabling providers' pain points through its product use. Remunerations are tied to hospital performance. Frost & Sullivan notes that the Sensium System's ability to support early detection of any deterioration coupled with an outcome-centric approach leads to additional hospital capacity.

The company's overall product suite includes a single-use consumable patch lasting 5 to 6 days, a bridge that connects to hospital information technology infrastructure, and server software for the hospital server stack. The company also offers a range of integration services and additional software packages for electronic observation capture of other vital signs and management reporting functionality. A major share of company revenue comes from the recurring purchase of the disposable patch. Sensium is currently working on a home-based solution to enable hospital-grade diagnosis for discharged patients. This Hospital@Home solution will be commercially available in late 2020. Frost & Sullivan notes that such a development will help hospitals reach beyond traditional infrastructure by providing oversight of managed home care providers, enabling additional capacity. The model is expected to yield significant growth to the company in the future.

Customer Acquisition

Currently, the device is deployed in 10 hospitals (two hospitals in the United Kingdom, four in France, and four in the Netherlands), and is at various stages of roll-out, ranging from niche to multiple ward-type deployments. The feedback has been positive and multiple published case studies identify the Sensium System's ability to identify deterioration early. Moreover, unlike most competitors, the company can seamlessly integrate the solution into the existing care protocol. Sensium has invested in clinical support functions and training programs which are CPD-accredited. Sensium also enables patients to be placed in optimal care settings to enhance healing, thus decreasing costs, complications (e.g., infections), and the burden on clinical workflows. The System also delivers notifications to the right person at right time without hindering the workflow of clinicians or nurses.

Frost & Sullivan research reveals that the Sensium System yields a potential cost savings of GBP 466 per patient and GBP 700,000 per hospital ward annually by preventing readmissions and decreasing the length of stay. The System also facilitates the treatment of patients in appropriate care settings. For example, regular vital signs monitoring can be performed in general care wards, helping reserve the ICU and other high-dependency wards

for only the most at-risk patients. As a result, the total cost of care is decreased while patients can recover in the most suitable setting for their condition.

Conclusion

Health systems globally face tough challenges due to the constantly increasing cost of care delivery, higher rates of preventable complications due to chronic disease, and resource-constrained healthcare infrastructure. Sensium leverages a technology-enabled care delivery model to decrease the cost of care to patients, payers, and providers. The company's innovative Sensium solution, a clinically validated System that can diagnose the warning signs of patient deterioration, cost-effectively optimizes patient outcomes by supporting early intervention. Due to its proven efficacy, the Sensium System has been adopted by the UK's National Health Service as well as leading hospital systems in the Netherlands and France.

With its technical excellence, superior performance, and potential to significantly improve the standard of care, Sensium earns Frost & Sullivan's 2020 Technology Innovation Leadership Award in the European wearable remote patient monitoring market.

Significance of Technology Innovation Leadership

Technology-rich companies with strong commercialization strategies benefit from the demand for high-quality, technologically innovative products that help shape the brand, resulting in a strong, differentiated market position.

Understanding Technology Innovation Leadership

Technology innovation leadership recognizes companies that lead the development and successful introduction of high-tech solutions to customers' most pressing needs, altering the industry or business landscape in the process. These companies shape the future of technology and its uses. Ultimately, success is measured by the degree to which a technology is leveraged and the impact it has on growing the business.

Key Benchmarking Criteria

For the Technology Innovation Leadership Award, Frost & Sullivan analysts independently evaluated 2 key factors—Technology Leverage and Business Impact—according to the criteria identified below.

Technology Leverage

Criterion 1: Commitment to Innovation
Criterion 2: Commitment to Creativity
Criterion 3: Technology Incubation
Criterion 4: Commercialization Success
Criterion 5: Application Diversity

Business Impact

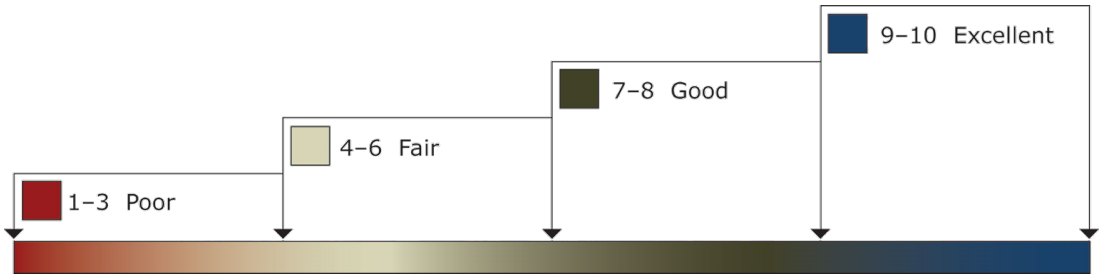
Criterion 1: Financial Performance
Criterion 2: Customer Acquisition
Criterion 3: Operational Efficiency
Criterion 4: Growth Potential
Criterion 5: Human Capital

Best Practices Award Analysis for Sensium

Decision Support Scorecard

To support its evaluation of best practices across multiple business performance categories, Frost & Sullivan employs a customized Decision Support Scorecard. This tool allows research and consulting teams to objectively analyze performance according to the key benchmarking criteria listed in the previous section, and to assign ratings on that basis. The tool follows a 10-point scale that allows for nuances in performance evaluation. Ratings guidelines are illustrated below.

RATINGS GUIDELINES



The Decision Support Scorecard considers Technology Leverage and Business Impact (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criterion are provided beneath the scorecard). The research team confirms the veracity of this weighted scorecard through sensitivity analysis, which confirms that small changes to the ratings for a specific criterion do not lead to a significant change in the overall relative rankings of the companies.

The results of this analysis are shown below. To remain unbiased and to protect the interests of all organizations reviewed, Frost & Sullivan has chosen to refer to the other key participants as Competitor 1 and Competitor 2.

Measurement of 1–10 (1 = poor; 10 = excellent)			
Technology Innovation Leadership	Technology Leverage	Business Impact	**Average Rating**
Sensium	**9**	**9**	**9**
Competitor 1	7	9	8
Competitor 2	8	7	7.5

Technology Leverage

Criterion 1: Commitment to Innovation

Requirement: Conscious, ongoing development of an organization's culture that supports the pursuit of groundbreaking ideas through the leverage of technology.

Criterion 2: Commitment to Creativity

Requirement: Employees rewarded for pushing the limits of form and function by integrating the latest technologies to enhance products.

Criterion 3: Technology Incubation

Requirement: A structured process with adequate investment to incubate new technologies developed internally or through strategic partnerships.

Criterion 4: Commercialization Success

Requirement: A proven track record of commercializing new technologies by enabling new products and/or through licensing strategies.

Criterion 5: Application Diversity

Requirement: The development of technologies that serve multiple products, multiple applications, and multiple user environments.

Business Impact

Criterion 1: Financial Performance

Requirement: Overall financial performance is strong in terms of revenue, revenue growth, operating margin, and other key financial metrics.

Criterion 2: Customer Acquisition

Requirement: Overall technology strength enables acquisition of new customers, even as it enhances retention of current customers.

Criterion 3: Operational Efficiency

Requirement: Staff is able to perform assigned tasks productively, quickly, and to a high quality standard.

Criterion 4: Growth Potential

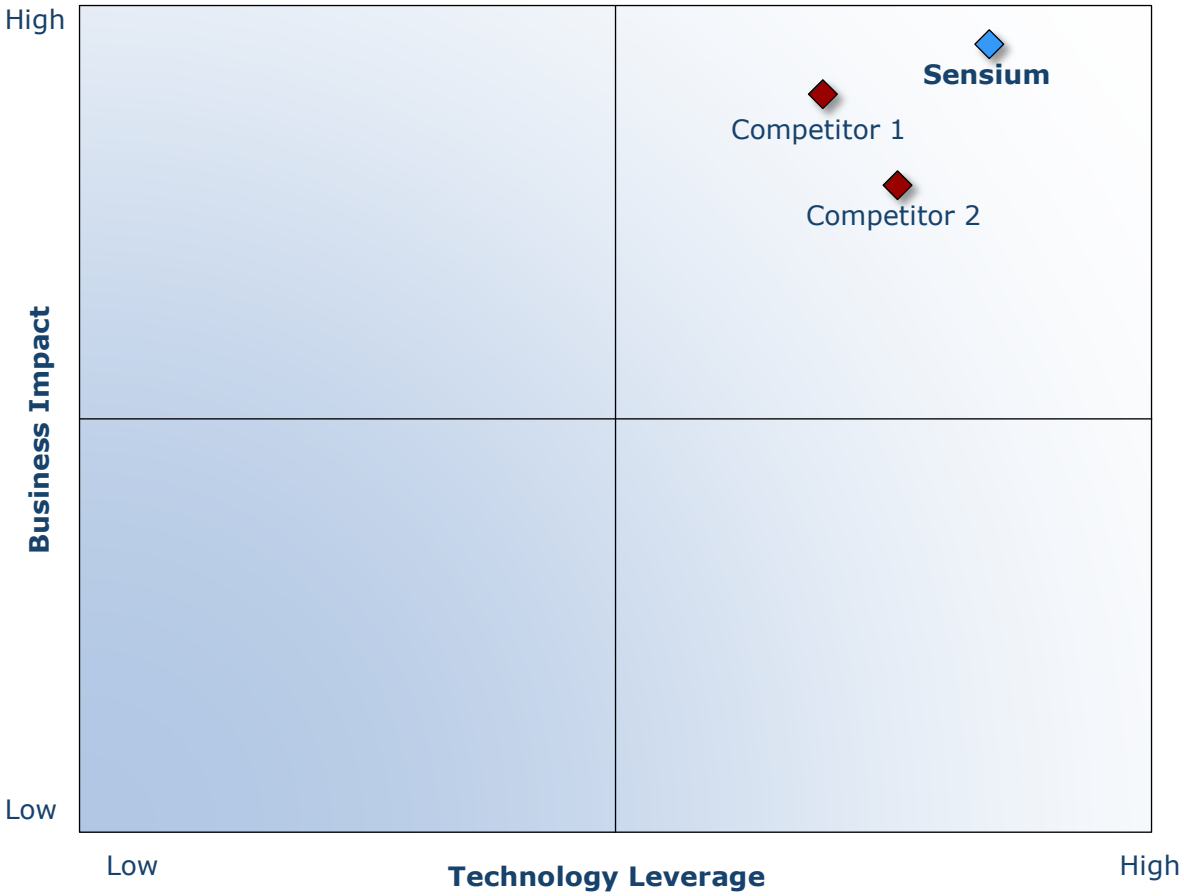
Requirements: Technology focus strengthens brand, reinforces customer loyalty, and enhances growth potential.

Criterion 5: Human Capital

Requirement: Company culture is characterized by a strong commitment to customer impact through technology leverage, which enhances employee morale and retention.

Decision Support Matrix

Once all companies have been evaluated according to the Decision Support Scorecard, analysts then position the candidates on the matrix shown below, enabling them to visualize which companies are truly breakthrough and which ones are not yet operating at best-in-class levels.



Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate award candidates and assess their fit with select best practices criteria. The reputation and integrity of the awards are based on close adherence to this process.

STEP		OBJECTIVE	KEY ACTIVITIES	OUTPUT
1	**Monitor, target, and screen**	Identify award recipient candidates from around the world	• Conduct in-depth industry research • Identify emerging industries • Scan multiple regions	Pipeline of candidates that potentially meet all best practices criteria
2	**Perform 360-degree research**	Perform comprehensive, 360-degree research on all candidates in the pipeline	• Interview thought leaders and industry practitioners • Assess candidates' fit with best practices criteria • Rank all candidates	Matrix positioning of all candidates' performance relative to one another
3	**Invite thought leadership in best practices**	Perform in-depth examination of all candidates	• Confirm best practices criteria • Examine eligibility of all candidates • Identify any information gaps	Detailed profiles of all ranked candidates
4	**Initiate research director review**	Conduct an unbiased evaluation of all candidate profiles	• Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles	Final prioritization of all eligible candidates and companion best practices positioning paper
5	**Assemble panel of industry experts**	Present findings to an expert panel of industry thought leaders	• Share findings • Strengthen cases for candidate eligibility • Prioritize candidates	Refined list of prioritized award candidates
6	**Conduct global industry review**	Build consensus on award candidates' eligibility	• Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates	Final list of eligible award candidates, representing success stories worldwide
7	**Perform quality check**	Develop official award consideration materials	• Perform final performance benchmarking activities • Write nominations • Perform quality review	High-quality, accurate, and creative presentation of nominees' successes
8	**Reconnect with panel of industry experts**	Finalize the selection of the best practices award recipient	• Review analysis with panel • Build consensus • Select recipient	Decision on which company performs best against all best practices criteria
9	**Communicate recognition**	Inform award recipient of recognition	• Announce award to the CEO • Inspire the organization for continued success • Celebrate the recipient's performance	Announcement of award and plan for how recipient can use the award to enhance the brand
10	**Take strategic action**	Upon licensing, company is able to share award news with stakeholders and customers	• Coordinate media outreach • Design a marketing plan • Assess award's role in strategic planning	Widespread awareness of recipient's award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of the research process. It offers a 360-degree view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, resulting in errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry players and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, helps clients accelerate growth and achieve best-in-class positions in growth, innovation, and leadership. The company's Growth Partnership Service provides the CEO and the CEO's growth team with disciplined research and best practice models to drive the generation, evaluation and implementation of powerful growth strategies. Frost & Sullivan leverages nearly 60 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on 6 continents. To join Frost & Sullivan's Growth Partnership, visit http://www.frost.com.